Student at work at Arlington Elementary in Fayette County. **Photo by Rick McComb.**

Goal 5: Think and Solve Problems

Academic Expectation

5.1: Students use critical thinking skills such as analyzing, prioritizing, categorizing, evaluating, and comparing to solve a variety of problems in real-life situations.

Learning Links: Investigation / Legislation / Legal Opinions / Construction / Experiments / Computer Programming / Inventions / Jury Decisions / Chess / Conservation / Strategic Planning / Consumerism

Elementary Demonstrators

Middle School Demonstrators

High School Demonstrators

Demonstrators should be read from bottom to top, but need not be demonstrated sequentially.

Elementary	Middle School	High School
• Form and defend an opinion based on multiple perspectives.	• Generate possible solutions to problems; predict effects of actions.	• Propose solutions to problems; predict effects of actions; set priorities; act; evaluate effectiveness.
• Examine cause-and-effect relationships.	• Analyze cause-and-effect relationships.	• Analyze assertions for bias/relevance/assumptions.
• Recognize sequential relationships.	• Analyze information for bias/relevance/ambiguity.	
• Classify ideas/objects/situations into categories.	• Examine ideas/objects/situations for patterns; discern discrepancies.	
• Discover patterns in life situations.		

Sample Teaching/Assessment Strategies: _____

Graphic Organizers: Compare/Contrast Structures, Flowchart, Mapping/Webbing, Matrix, Venn Diagram • **Problem Solving:** Heuristics, Inquiry, Formulating Models, Research • **Technology/Tools:** Manipulatives, Games • **Whole Language Approach** • **Writing Process**

These sample strategies offer ideas and are not meant to limit teacher resourcefulness. More strategies are found in the resource section.

Ideas for Incorporating Community Resources: _____

• Ask a state trooper or local attorney to discuss the investigation and mediation process of auto accidents where both parties believed they were not guilty.

• Interview city commission members about how they make decisions.

• Meet with local loan officers to obtain information on the process for determining loan eligibility.

• Interview a number of agribusiness representatives about the process for determining the kinds of crops and livestock to raise.

Core Concept: Critical Thinking

Sample Elementary Activities

- Conduct a jury trial based on an incident from a story you are reading. Investigate how different perspectives change the outcome. PE, OE
- Investigate the causes of accidents on the playground. Propose solutions to reduce the accidents. PE, OE
- Design a new multimedia learning center for your classroom. Develop a plan to implement the center and present to your classmates. PE
- Invent new rules for a favorite game. Analyze how this changes the game. PE, P

Sample Middle School Activities

- Present a skit to depict the problems a family might have if a particular appliance were removed from the house. Generate possible solutions and predict the effects. PE, OE
- Investigate the use of all paper products in your school. Propose conservation measures. PE, OE
- Write, dramatize, and videotape a mystery with alternative endings. Select the most plausible ending and defend. PE, OE, P
- Analyze cafeteria food for fat and sugar content. Compile the information using a database. Compare with recommended levels. Make suggestions to the cafeteria manager. PE, OE, P

Sample High School Activities

- Distinguish the benefits and limitations of different forms of government (e.g., democracy, socialism, communism). Develop a political cartoon or comedy routine about a benefit or limitation. PE, OE, P
- Choose two media sources. Analyze the bias of each type of news. Write an article to be presented by each source (e.g., radio, newspaper). PE, OE, P
- Select an invention of the Industrial Revolution. Determine what expected and unexpected effects resulted from the invention. PE, OE
- Research the major issues of a year and present a "State of the Union" address. Compare to the actual address. Defend the changes in your address. PE, OE, P

Reflections

This academic expectation focuses on the ability of students to think critically; to analyze, synthesize and evaluate. It is a skill which should be embedded in solving any problem or making any judgment.

The learning goals and academic expectations of KERA require that we rethink the idea of focusing on isolated bits of information. The teaching of facts and theories may not be as important as the development of critical thinking skills which can be applied to any content or idea in the discipline. For example, in science, where new "facts" are added to the knowledge base everyday, it is crucial that students learn how to "sort sense from nonsense," or have the ability to grasp information, examine it, evaluate its soundness, and apply it.

The development of sound critical thinking skills produces students and citizens who can approach situations in school and life with the ability to make sound decisions and wise choices.

Source: Ennis—Evaluating Critical Thinking

Johnson, Johnson and Smith—Active Learning: Cooperation in the College Classroom

Paul—Critical Thinking Handbooks, Volumes 1-4

Goal 5: Think and Solve Problems

Academic Expectation

5.2: Students use creative thinking skills to develop or invent novel, constructive ideas or products.

Learning Links: Designs / Inventions / Think Tanks / Technology / Advertising / Brainstorming / Creative Arts / Humor / Toys/Games / Theatre Sets/Costumes / Theatres

Elementary Demonstrators

Middle School Demonstrators

High School Demonstrators

Demonstrators should be read from bottom to top, but need not be demonstrated sequentially.

Elementary Demonstrators	Middle School Demonstrators	High School Demonstrators
• Create a new solution or idea. • Expand and analyze ideas and products. • Generate a variety of ideas and products.	• Assess newly generated solutions/ideas/products to test validity and utility. • Create a new solution/idea/product. • Generate, expand, and analyze ideas and products.	• Analyze the process used to develop the newly generated solutions/ideas/products. • Assess newly generated solutions/ideas/products to test validity and utility. • Generate, expand, analyze, and create ideas and products using a variety of resources.

Sample Teaching/Assessment Strategies: _____

Collaborative Process: Cooperative Learning • **Continuous Progress Assessment**: Portfolio Development, Performance Events/Exhibitions, Observation • **Graphic Organizers**: Graphic Representations, Mapping/Webbing, Storyboard • **Problem Solving**: Research, Creative Problem Solving, Future Problem Solving, Debate, Formulating Models, Role-play, Simulation, Brainstorming • **Technology/Tools:** Manipulatives, Computers, Interactive Video, Multimedia, Videotaping • **Whole Language Approach** • **Writing Process**

These sample strategies offer ideas and are not meant to limit teacher resourcefulness. More strategies are found in the resource section.

Ideas for Incorporating Community Resources: _____

• Invite local inventors to discuss their approaches to inventions.

• Invite a local artist, craftsperson, or graphic designer to discuss the creative process.

• Participate in Odyssey of the Mind, science fairs, Imagination Celebration, or Invent America.

• Interview local writers to learn how they generate ideas.

Core Concept: Creative Thinking

Sample Elementary Activities

- Create a mobile or sculpture using recyclable products. PE
- Create a suggestion box for school issues. Select the most novel and constructive. Plan a campaign to implement the suggestion. PE, OE, P
- Explore products made in your community; analyze how these impact the community; propose ways to improve the product. PE, OE

Sample Middle School Activities

- Brainstorm ideas and generate low cost, efficient proposals to increase the community's access to exercise activities. PE, OE, P
- Create a moving sculpture to represent an idea. PE, OE
- Design a print or video advertisement for your favorite book or song. PE, OE

Sample High School Activities

- Use MIDI interface, graphics, hypermedia sound, or art tools to create images and ideas. PE
- Develop and implement hands-on approaches to teach science concepts to elementary students. PE, OE, P
- Develop and present for a school-based council a "state of the school" address which focuses on an aspect of the school's programs. Include suggestions for new programs or revisions for old ones. PE, OE, P

Reflections

Young children are naturally curious and creative. They play and use their imaginations in wonderful ways creating friends, monsters, and heroes. They love music and dancing. Their enthusiasm and excitement know no bounds. Traditional approaches to education often squelch that "joie de vivre."

Why should we foster creative thinking throughout a student's education? Creative thinkers are the inventors, poets, and explorers of our heritage. It is they who have given us Velcro, Post-It Notes, and "The Moonlight Sonata." Without the products of creative thinkers, we would dwell in caves without fire or drawings to remind us of the hunt, and our lives would be untouched by the spark of their creativity.

Goal 5: Think and Solve Problems

Academic Expectation

5.3: Students organize information to develop or change their understanding of a concept.

Learning Links: Models / Networking / Statistics / Budgets / Databases / Experiments / Reporting / Composition / Research / Index / Directory / Schedules / Choreography / Census

Elementary Demonstrators

Middle School Demonstrators

High School Demonstrators

Demonstrators should be read from bottom to top, but need not be demonstrated sequentially.

Elementary Demonstrators	Middle School Demonstrators	High School Demonstrators
• Use data to modify, develop, and test concepts. • Identify connections between new information and prior knowledge. • Gather, sort, and re-sort information into categories. • Classify objects by characteristics.	• Develop and test concepts based on new information and experience. • Analyze the connections between new information and prior knowledge. • Organize information into categories. • Gather information from multiple sources to derive meaning.	• Synthesize information to form a new concept and/or modify an old concept; test the concept with new information and modify. • Assess the interrelationships between theories and concepts. • Analyze a concept to extract and identify supporting components.

Sample Teaching/Assessment Strategies:

Collaborative Process: Cooperative Learning, Peer Tutoring • **Continuous Progress Assessment:** Portfolio Development • **Graphic Organizers:** Compare/Contrast Structures, Graphic Representations, Mapping/Webbing, Matrix, Storyboard, Story Map, Venn Diagram • **Problem Solving:** Formulating Models, Creative Problem Solving, Future Problem Solving, Debate, Simulating • **Technology/Tools:** Manipulatives, Computers, Games, Interactive Video, Multimedia, Puppets • **Whole Language Approach** • **Writing Process**

These sample strategies offer ideas and are not meant to limit teacher resourcefulness. More strategies are found in the resource section.

Ideas for Incorporating Community Resources:

• Invite a computer programmer to discuss how information can be organized for different purposes.
• Contact Junior Achievement and the Kentucky Council on Economic Education for information on marketing programs.
• Interview a local reporter about gathering and organizing information to develop an idea for a news report.
• Visit a manufacturing plant to discuss its process for developing new products.

Core Concept: Conceptualizing

Sample Elementary Activities

- Redesign your classroom to make it more efficient. PE
- Publish a school directory of hobbies. Form networks of similar interest. PE, OE
- Design a new box for a favorite cereal so that it would more likely to be bought by your peers. PE, OE
- Read a book and watch the movie version of it. Analyze how the two types of media support different understandings of the concepts. OE, P

Sample Middle School Activities

- Design and make a model of a city which includes a transportation network, emergency services, facilities, parks, and utilities (e.g., water, sewer). PE, OE
- Create a display for the school cafeteria based on a conservation theme. PE, OE, P
- Create a database of community artists/crafts people. Provide a variety of classification schemes to assist someone who uses the database. PE, OE, P
- Design a storyboard of a favorite story for an elementary classroom. PE, P

Sample High School Activities

- Analyze a local schoolyard or park for common plant and animal species. Make a model or other representation of what the area might look like in the year 3000 if ozone depletion, global warming, and increased ultraviolet radiation become realities. Explain your representation in terms of the concepts of adaptation, succession, and evolution. PE, OE, P
- Write and perform a play called "You Are What You Eat." Convey the concepts and relationships among diet planning, exercise, weight gain or loss, and calorie intake/utilization. PE, OE, P
- Choose a political system issue or philosophy and trace the underlying structures and principles which support it. Dramatize the development process. PE, OE, P.
- Use a CAD program to create a building to meet specific zoning requirements. PE

Reflections

Being able to see a larger perspective, rather than just a small piece of the whole, enables students to see the relevance of their work. To focus constantly on the pieces, rather than how they fit together, is frustrating to both teacher and student.

The ability to take abstract ideas, reflect on them and then organize them in some manner to see how the parts relate to one another is the basis for conceptualizing. Students who master the ability to think conceptually are able to solve problems and make decisions which will not only have beneficial effects on their time in school, but also help them select careers from wider ranges such as mathematics, music, medicine, or another field based upon the aptitudes.

Goal 5: Think and Solve Problems

Academic Expectation

5.4: Students use a decision-making process to make informed decisions among options.

Learning Links: Career / Editing / Consumerism / Planning / Voting / Marriage / Jury Decisions / Legislation / Offense/ Defense / Censorship / Feedback / Logic / Diagnosis

Elementary Demonstrators

Middle School Demonstrators

High School Demonstrators

Demonstrators should be read from bottom to top, but need not be demonstrated sequentially.

Elementary Demonstrators	Middle School Demonstrators	High School Demonstrators
• Analyze alternatives; make a decision.	• Monitor the effectiveness of a decision over time.	• Choose and defend an option; make a decision; monitor and adjust the effectiveness of a decision over time.
• Predict consequences for solutions.	• Analyze and prioritize alternatives; select and defend a decision.	• Predict and analyze consequences of options.
• Define a goal, gather information, and generate alternative solutions.	• Predict consequences for solutions and establish evaluative criteria.	• Recognize options; gather information; propose alternative options.
• Make a decision from given options.	• Recognize options; gather information; propose alternative options.	
• Identify daily decisions.		

Sample Teaching/Assessment Strategies:

Collaborative Process: Cooperative Learning • **Community-Based Instruction:** Mentoring/Apprenticeship/Co-op, Service Learning, Shadowing • **Continuous Progress Assessment**: Portfolio Development • **Graphic Organizers**: Advance Organizers, Compare/Contrast Structures, Flowchart, KWL, Outlining, Sequence Chain, Time Line, Storyboard, Mapping • **Problem Solving**: Inquiry, Heuristics, Brainstorming, Case Studies, Future Problem Solving, Debate, Interviews/Surveys/Polls • **Whole Language Approach** • **Writing Process**
These sample strategies offer ideas and are not meant to limit teacher resourcefulness. More strategies are found in the resource section.

Ideas for Incorporating Community Resources:

• Communicate with professors of philosophy about the role of logic in decision making.

• Invite a local physician to discuss decisions about diagnosis and treatment.

• Observe a local planning meeting to see how decisions are made.

Core Concept: Decision Making

Sample Elementary Activities

- Keep a journal for one week, noting decisions you made. Compile into a database of class decisions. Analyze alternative solutions which were made and could have been made. OE, P
- Establish a personal criteria for your toys. Evaluate the toys you currently want, using the criteria. Prioritize your list. OE, P
- Develop a list of books to purchase for your classroom. Consider your interest and those of your classmates. OE, P

Sample Middle School Activities

- Design a landscape plan for the entrance area to your school. Explain the decision for selecting the plants and their placement. PE, OE
- Research the position of two political candidates on an important issue. Determine which one to support and defend your choice. OE, P
- Investigate a variety of resources to develop criteria for making the best buy of a product you want. Apply the criteria in making the purchase. Evaluate your decision-making process to determine if you really made the "best buy." PE, OE
- Develop a weekly budget based on a given amount of money. Decide how much money is required to cover the expenses of lunch, school supplies, and extras. Use the budget for a week and evaluate the effectiveness of your budgeting decisions. PE, OE, P

Sample High School Activities

- Decide what kind of computer and software to purchase for your home which will interface with school technology and your projected needs. Create a priority purchasing plan based on budget and use. PE, OE, P
- Research the ingredients in several of your favorite "junk foods." Analyze the health effects of these ingredients, develop a priority chart of pleasures and risks involved in eating each food, and decide whether or not to continue eating it. Explain your choices in a piece developed for a portfolio. PE, OE, P
- Research the programs offered by several post-secondary institutions. Develop criteria to evaluate the institutions. Contact personnel at the institution, current and former students, and community people with knowledge about the institution. Use the information gathered and criteria developed to decide which institution to attend. PE, OE, P
- Establish guidelines for selecting an automobile insurance company and decide on a company with which to insure your vehicle. Create criteria for judging your decision and evaluate it at regular intervals. PE, OE, P

Reflections

According to Costa, intelligent behavior is knowing what to do when you don't know what to do. It's understanding the issue, its consequences, the alternatives, and then making the best decision. Students need practice in making meaningful decisions that require mindful analysis of all the options.

Good decision making is a process that includes critical thinking, creative thinking, and conceptualizing. Students who are able to incorporate these elements in the decision-making process will benefit from good decision-making skills in consumerism, voting, education, marriage, and work choices.

Source: Costa—The School as a Home for the Mind

Goal 5: Think and Solve Problems

Academic Expectation

5.5: Students use problem-solving processes to develop solutions to relatively complex problems.

Learning Links: Crime / Deficit / Racism / Mysteries / Legislation / Scheduling / Diagnosis / Budgets / Crisis / Conflict Resolution / Conservation / Technology / Planning/Design

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Elementary Demonstrators

Middle School Demonstrators

High School Demonstrators

Demonstrators should be read from bottom to top, but need not be demonstrated sequentially.

Elementary Demonstrators	Middle School Demonstrators	High School Demonstrators
• Choose a solution; evaluate the effectiveness of solution.	• Apply criteria to alternative solutions.	• Implement a solution; evaluate its effectiveness; monitor and adjust as needed.
• Consider alternative solutions to a problem.	• Establish evaluative criteria for testing alternative solutions.	• Justify the strategy and solutions, based on the evaluative criteria.
• Explore strategies to solve a problem.	• Identify alternative solutions to a problem.	• Establish and apply evaluative criteria for testing alternative solutions.
• Gather and organize information on a problem.	• Define a problem; gather and organize information about the problem.	• Gather and organize information on alternative solutions to a defined problem.
• Identify a problem.		

Sample Teaching/Assessment Strategies: _____

Collaborative Process: Cooperative Learning • **Continuous Progress Assessment:** Portfolio Development, Performance Events/Exhibitions • **Graphic Organizers:** Compare/Contrast Structures • **Problem Solving:** Brainstorming, Heuristics, Inquiry • **Technology/Tools:** Manipulatives, Computers • **Whole Language Approach** • **Writing Process**

These sample strategies offer ideas and are not meant to limit teacher resourcefulness. More strategies are found in the resource section.

Ideas for Incorporating Community Resources: _____

• Invite local disaster preparedness official (e.g., Civil Defense representative, National Guard) to discuss problems encountered during a disaster.

• Visit a local government meeting to observe how problems are addressed.

• Interview the owner of a small business to determine problems experienced in setting up a business.

Core Concept: Problem Solving

Sample Elementary Activities

- Create a questionnaire to identify a problem which exists at school. Record the data on a database and graph the result. Brainstorm solutions and recommend one to your teacher or principal. PE, OE, P
- Write and perform a drama which presents a solution to an "unsolved" mystery from your community history. PE, OE, P
- Read a story and create a list of problems confronted by the characters. Choose one problem and develop a possible solution. OE, P
- Design and build a hot air balloon using tissue paper. Complete a test flight. Describe the problems confronted in the process and explain how solutions were developed. PE, OE, P

Sample Middle School Activities

- Design a container to ship a fragile object (e.g., egg, bottle). Experiment with the design to verify its effectiveness (e.g., drop, toss). PE, OE
- Write a bill which proposes solutions to a resource conservation issue. Prepare a list of supporting arguments and present to your legislator. PE, OE, P
- Propose solutions to the student council for the restroom graffiti problem. PE, OE
- Assess your learning strengths and weaknesses. Find a peer who complements your weaknesses. Develop a plan to monitor improvement. PE, OE, P

Sample High School Activities

- Design, build, and select a site for a doghouse which will most efficiently protect the dog from fluctuations in temperature. PE, OE
- Redesign the existing school program so that it is appropriate for meeting the demands of education reform in Kentucky. Present your recommendations to the school-based council. PE, OE, P
- Identify reasons why a machine (e.g., car, lawn mower, sewing machine) is not working properly. Apply a problem-solving process and repair the machine. Check periodically to ensure that the machine continues to work. PE, P
- Organize a team forum to examine issues which affect the youth of the community. Invite public officials to attend and respond to the issues. Research possible solutions and present your findings to the forum participants. PE, OE, P

Reflections

One of the goals of education is to ensure that students leave school with a repertoire of strategies for solving problems. It is through a combination of skills that students arrive at viable solutions to problems. With skills in analyzing, brainstorming, and evaluating, students are equipped to handle problems of any variety.

Whatever the subject, it is important that students be exposed to an effective problem-solving model. It is even more important that through an interdisciplinary team approach, these discrete models can be discussed, compared, and reconciled for better student understanding and future application.

Sources: Fogarty, Perkins and Barell—The Mindful School: How to Teach for Transfer

Notes